

US6185490: Vehicle crash data recorder

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Abstract:

A vehicle data recorder useful in recording and accessing data from a vehicle accident comprised of; a microprocessor based system that will have in the preferred embodiment four inputs from the host vehicle, and four inputs from the internal sensors. The apparatus is arranged with a three-stage memory to record and retain the information and is equipped with a series and parallel connectors to provide instant on scene access to the accident data. This invention includes a plurality of internally mounted devices necessary to determine vehicle direction, rollover detection, and impact forces. The plurality of inputs from the host vehicle include in the preferred embodiment, the speed of the vehicle, seat belt use, brake activation, and whether or not the transmission is in forward or reverse gear.

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I claim:

1. A self-contained apparatus to be installed upon motor vehicles for detecting and recording vehicle operating systems data and vehicle response to kinetic forces that act upon the vehicle during an accident trigger event, comprising:

- a plurality of electrical connections for collecting pertinent data on vehicle systems, said data including speed of the vehicle, seat belt use, forward or reverse gear status and brake activation, said data being in part analog and in part digital; and
- a multistage memory scheme for storing collected vehicle data, the memory scheme including a short term active memory capable of retaining a short time segment of collected data, a second stage cache memory to temporarily store data transferred from the active memory to prevent overwriting of data stored in the

active memory and a non-volatile memory capable of permanently storing data for periods of at least 30 days.

Background/Summary:

FIELD OF THE INVENTION

This invention in general relates to vehicle data recorders. More specifically, the invention is a vehicle data recorder using microprocessor controlled electronics a two stage random access memory, and a non-volatile memory to retain the vehicle identification number and data on impact forces, brake activation, seat belt use, vehicle speed, vehicle direction, vehicle rollover, and the date and time of the incident.

BACKGROUND OF THE INVENTION

Prior Art

In 1997, the most recent year for which data is available, there were 6,764,000 police reported accidents according to the National Highway safety Board. These accidents caused an estimated \$150,000,000,000.00 in economic losses and about 47,000 lives. This invention, hereinafter referred to as the Vehicle Data Recorder, or "VDR" is designed to save lives and money by providing instant access to critical information about a motor vehicle accident.

The VDR is unique because it is a self-contained modular unit easily installed on any motor vehicle. It will monitor and record data on eight data channels, three from internal event triggered sensors, one from an internal electronic compass, and four from the host vehicle. The data will be stored in memory in a time correlated file format which upon power interruption, will be transferred to permanent data storage, where it will be available for download to any Windows® based computer via a serial connection.

Consider the following example. A squad is called to the scene of a single car motor vehicle. The patient is unconscious and unable to tell the paramedics what happened. The paramedics would treat this patient for obvious visible life threatening injuries and transport him to the nearest trauma center. The trauma center would try to stabilize the patient and start test to determine the extent of the patient's injuries. With access to the type of information provided by this invention, you would know the vehicle identification number and that the vehicle was involved in a head on collision on Jun. 9, 1998 at 7:57:35 PM. You would know that the vehicle was traveling at 47.5 mph at the time of the 10 g collision and that the driver had swerved 30 degrees to his left and applied his brakes exactly 0.3 sec prior to the crash and that he had been wearing his seatbelt. Instant access to this type of detailed information will allow EMS and subsequently hospital personnel to focus attention and resources upon the most serious and life threatening injuries. It will also start the clock on the "Golden Hour" with a time certain, thus encouraging a quicker decision for a load and go situation. Medical personnel would not be the only group interested in this data. The following would have at least as much interest in this information as well.

1. Police.
2. Insurance Companies.
3. State and Federal Government agencies.
4. Automotive companies.

The foundation upon which all accident investigations is built is the written report compiled by the police officers at the scene. This report contains a variety of information, some of it based upon observation, such as, road and weather conditions, or hazardous environmental or construction obstacles that might have contributed to the accident. The balance of the report is comprised of estimation, hearsay, or calculation, I.E. the speed of the vehicle, was the seatbelt fastened, how hard and where was the initial impact, and did a rollover occur.

The availability of an electronic accident report coded with the vehicle identification number for vehicle identification and containing precise information about a motor vehicle accident would allow the insurance companies to create a more accurate database from which actuarial calculations could be made. More accurate calculations would lead to a more equitable distribution of risk and therefore rates could be based upon car and driver records that would be more accurate than anything currently available. Government involvement in highway safety has always had the dual aim of saving lives, and reducing the enormous economic losses attributed to motor vehicle accidents. To this end they have maintained a data base on all motor vehicle accidents reported to them by the police. The electronic accident report will provide precise information from which to build a data base.

Vehicle data recorders have been the subject of earlier patents and often they have included inputs from brake pedal travel, accelerator position, turn signals, headlights, acceleration forces, and some have even included video inputs. Most vehicle data recorders, however, have concentrated on a static laboratory environment and staged accidents using specifically designed test vehicles. Data collection devices used on these test vehicles are expensive and sophisticated. Some of these devices include:

1. Gyroscopic devices.
2. Laser devices.
3. Video cameras.
4. Impact sensors.
5. Accelerometers.

The advantages and disadvantages of these devices in a real-world environment are as follows. Gyroscopic devices have proved themselves to be effective and accurate in a laboratory test vehicle, and in aircraft inertial navigation systems. They are, however, expensive, require a relatively long warm up period before stabilization can occur, and they consume a relatively large amount of power. In fact the power consumption of a gyroscopic device would require a complete re-design of the typical motor vehicle electrical system. Lasers also consume large amounts of power and are limited to being a reference from which to measure vehicle distortion after an impact. Video cameras, are now being used in some vehicles as stand alone data collection devices, but the

cameras focus will always be on the outside events. Specialized impact sensors, and accelerometers fall into the same broad category. They each have a function in a staged accident, but are not of any beneficial use in the real world unless coupled with a more encompassing system like the Vehicle Data Recorder.

Aviation has developed data collection devices that are unique to the demanding aspects of aviation. Flight Data Recorders have proved invaluable to the National Transportation and Safety Board when they had to investigate accidents. The unique and challenging nature of flight, and the tremendous forces that occur in an airplane crash, have contributed to the development of a very sophisticated recorder that is coupled to all essential operating systems in an aircraft that will withstand the tremendous forces of an airplane crash. The system is very expensive, in fact is so expensive that it is not even used in private aircraft. Several real world events and advances in technology first led me to conceive of the Vehicle Data Recorder. The three events are the car crash that killed princess Di, and the inability of the police to determine exactly what happened. An airplane crashed in Okinawa, and I was on an emergency call to an automobile accident where the hospital ask me a series of questions about the accident to try to determine the mechanism of injury. The technological advances in computer hardware, specifically faster and cheaper microprocessors, and the larger capacity storage devices developed within the past two years led me to believe that they might be utilized in such a way as to answer my questions about mechanism of injury.

The purpose of the Vehicle Data Recorder, therefore is to provide an economical and reliable means to collect essential real world data about how a vehicle behaves during an accident. Following is a summary of relevant vehicle data recorder patents. 1. Decker et al U.S. Pat. No. 4,533,962.

A method and apparatus for sensing and recording diverse operational and performance characteristics of automotive vehicles and the like has a plurality of transducers directly associated with different mechanical functions of the vehicle for sensing their operating characteristics in relation to time as well as generating analog signals representative of certain functions and combining them with digital signals representing other functions. A signal converter encodes signals from the transducers in predetermined order into digital data signals. Each succession of signals generated are temporarily stored. A recorder then records information stored serially and enables ready access to and identification of each event or condition. After recordation of information over a selected time interval, the recording is automatically erased as additional information is transmitted to the recorder to provide a current history over limited time intervals, such as 30 minutes so as to be especially useful in accident analysis.

The Decker recorder provides a method for sensing and recording numerous operational and performance characteristics of a host vehicle. The Decker system is based on the placement of numerous transducers throughout the host vehicle and associating the electromechanical output of the transducer with the specific vehicle system such as brake pedal travel, and wheel rotation to determine speed. The recorder portion of the system writes to a continuous tape loop discrete blocks of data representing vehicle operation. 2. Zottnik, U.S. Pat. No. 4,638,289

An accident data recorder for short-time recordation and storage of data and events relating to an accident of motor vehicles, comprising pickups for sensing, for example, wheel revolutions to determine the traveled distance and speed of the vehicle. In

addition to these wheel sensors, capacitance-based acceleration sensors are provided whose output signals along with the output signals of the wheel sensors and with other status data relating to the operation of the vehicle, are continuously recorded at storage locations of a fixed storage. For this purpose, an addressing logic is provided which operates in a closed counting loop and, as soon as a final address is reached jumps back to the starting address to overwrite the initially stored data. The cyclic data storage is interrupted by the occurrence of a trigger event defining an accident, with the result that the last recorded data, including a predetermined after-travel time, are frozen.

The Zottnik device is basically a short duration recorder that receives input from various sensors located around the host vehicle and uses an addressing logic which operates in a closed counting loop to store data until the final address is reached, at which time it jumps back to the beginning and writes over the previously stored data. When a trigger event occurs such as a vehicle accident the data in storage is permanently stored for later analysis. 3. Takeuchi et al U.S. Pat. No. 4,866,616

Vehicle information such as vehicle speed, engine rotation speed when a vehicle runs are collected and converted into numerical data every constant period of time and these numerical data are written and recorded into memory module. The memory module has therein a non-volatile memory and is detachably provided to a write unit attached to the vehicle. The data writing and power supply to the memory module from the write unit are executed by the contactless coupling using induction coils.

The Takeuchi recorder concentrates on inputs such as vehicle speed and engine rotation and is thus able to concentrate on information as it relates to drive times, drive distances, vehicle speed, and engine rotation. The information is gathered from using electromagnetic induction coils to sense the desired information and relay it to the module where it is recorded into memory. 4. McCracken U.S. Pat. No. 4,992,943

An invention which facilitates motor vehicle accident reconstruction by providing apparatus for detecting and storing data describing the status of a motor vehicle when it is involved in a collision. The invention includes a plurality of impact detectors, a microprocessor which obtains vehicle status data from the computer systems used in modern vehicles, and a memory, such as an EPROM, for storing data for later retrieval.

The McCracken recorder uses the vehicles onboard computer as its' source of data. The obtained data is not stored in memory until one of the many impact sensors located throughout the host vehicle triggers an event. The vehicle status is then stored in an EPROM non-volatile memory for later retrieval and analysis. The chief failing of the McCracken system is in the use of imbedded microprocessors, which only allow for limited program instructions and an EPROM memory which is essentially a one time recording device until reset by other programming devices. 5. Other patents considered relevant are contained in the appendix:

1. Ishigami patent#5,311,430 2. Camhi et al. patent#5,430,432 3. Yamawaki patent#5,446,659 4. Nishio patent#5,541,590 5. Woll et al. patent#5,581,464 6. Cuddihy et al. patent#5,608,629 7. Kikinis patent#5,815,093

None of these devices, however, do an adequate job of providing relevant information as it relates to a vehicle accident in a comprehensive self contained cost effective modular format. Neither do any of the prior inventions provide an electronic means of

vehicle identification, or a real world date and time of accident system. The prior inventions also fail to provide a means of instant on scene access to the stored data in a non-destructive way. The prior inventions also fail to provide for an internal backup rechargeable battery power source necessary to prevent loss of data prior to transfer to the non-volatile memory.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to provide for a novel and improved method and means for measuring and recording vehicle performance characteristics.

It is a further object of this invention to provide a novel and improved cost effective method and means of measuring and recording vehicle status prior to, during, and subsequent to a trigger event, which will be accurate and reliable, easy to install, and can be retrofitted to existing vehicles.

It is a further object of this invention to provide a novel and improved self-contained rechargeable power source for the purpose of completing the file routine and transferring same to a non-volatile memory device if a power interruption occurs either through cessation of vehicle operation by operator action or the occurrence of a trigger event that disrupts the vehicle electrical system.

It is another object of this invention to provide a novel and improved method and means of determining vehicle direction at all times.

It is a further object of this invention to provide a novel and improved method and means of correlating all discrete events in relation to actual date and time of occurrence and recording same.

Another object of this invention is to provide a novel and improved method and means of identifying and storing vehicle specific data files by correlating and incorporating the vehicle identification number in all files.

Another object of this invention is to provide for a novel and improved method and means of identifying either a side to side, or front to back vehicle rollover through the coordinating and comparing the data from the tilt meter and the electronic compass. A side to side rollover would be indicated by activation of the tilt meter without significant change in the compass heading readings. A front to back rollover would be indicated by activation of the tilt meter coupled with a 180 degree compass flip.